1898.	λ	Obs.	Spot.	1898.	λ	Obs.	Spot.
Apr. 12	167°·0	P.	Dark	May 8	279°·3	G.	White
May 30	169·0	M.		15	282·7	W.	Dark
	176·3	„	White	June 2	277·0	M.	White
June 8	173·5	„	„		278·2	P.	„
Apr. 5	197·6	W.	„	Mar. 5	299·3	H.	Dark
June 22	185·1	D.	„		300·4	W.	„
Apr. 22	232·9	M.	Dark	June 7	328·2	M.	„
May 6	286·9	D.	White	May 31	334·7	P.	White
	287·4	P.	„				

Notes.—Spot I. The bracketed observations relate to the combined mass of I. and XXXVII.

Spot XXIII. It is doubtful if the first observation refers to this spot.

Spot XXX. There were two spots here close together, and the bracketed positions probably relate to the preceding spot. Both spots were observed on May 3.

Spot XXVII. The bracketed observations relate to the combined mass of I. and XXXVII.

Graphical Method for the Determination of the Local Times of Contact in a Solar Eclipse. By F. C. Penrose, D.C.L., F.R.S.

Having first obtained (also graphically) an approximate time for the middle of the eclipse which may be depended upon, if carefully done, within a minute of time, let the reader be supposed to be looking in a southerly direction at a perspective projection, showing the circumstances of the eclipse formed on a plane at right angles to the direction of the Sun and Moon. As he must necessarily be rather nearer to the Moon than the geocentric distance, the *distance of the picture* would be somewhat less than the geocentric distance, and her semi-diameter and the other lunar elements would be augmented; but for convenience of calculation it is better to use the geocentric values, which would have the same relation to one another in projection, and to reduce the solar in inverse proportion. This need only be done to the semi-diameter, which is the only one of consequence.

In this projection the parallax which represents the observer's motion will be an arc of an ellipse dependent upon horizontal parallax and geocentric latitude; and the soli-lunar motion, as the arc is so small, admits of being represented by a straight line.

This being premised, the elements for constructing a diagram to show the circumstances of totality may be thus found.

First, compare the arguments given for the Sun and for H.P. and the Moon's semi-diameter in the *Nautical Almanac* for the same day at noon (unless, owing to longitude or other considera-

M M 2

tions, a midnight argument, or one for another noon would be nearer to the assumed time) with those given for the particular eclipse, and tabulate the differences ; then find from these the corrections required for the assumed time in simple proportion, giving for the assumed time the R.A. and declination of the Sun, the H.P. and the Moon's semi-diameter. Then find the hour angle, and with the geocentric latitude compute the values in the direction of R.A. and declination of the parallax, the tangent to the elliptic curve, and the extent of one minute's motion and the Sun's altitude, and from this compute the augmentation. We are now in a position to lay down on paper two straight lines, one representing the soli-lunar motion to be drawn through the place as above found for the solar and lunar centres, and the other representing the tangent to the parallactic curve drawn through the corresponding point of parallax. Mark on these lines the extent of one minute's motion, both previous to and subsequent to the assumed time, produced as might be required, and subdivided into scales of seconds of time.

It is now easy, if totality be possible, to find the points where the extremities of a radius $= S - s$ with its augmentation increment, will rest upon similar numbers of seconds on the soli-lunar and parallax scales, the western coincidence giving the second and the eastern the third contact.

Calculation of the times of 2nd and 3rd Contact for the Total Solar Eclipse at Ovar on 1900 *May* 28.

$$\left\{\begin{array}{ll} \text{Latitude of Ovar} & = \lambda = 40^\circ\ 51'\ \text{N.} \\ \text{Geocentric Latitude} = l & \left\{\begin{array}{l} \log \rho \sin l = 9{\cdot}81330 \\ \log \rho \cos l = 9{\cdot}87940 \end{array}\right. \\ \text{Longitude of Ovar} & = 34^{\text{m}}\ 32^{\text{s}}\ \text{W.} \end{array}\right.$$

Mid-totality at Ovar occurs at $4^{\text{h}}\ 2^{\text{m}}$ G.M.T. (approx.)

1900 May 28, $4^{\text{h}}\ 2^{\text{m}}$ G.M.T.

☉'s R.A.	$= a = 4^{\text{h}}\ 19^{\text{m}}\ 58^{\text{s}}{\cdot}33.$	Change in 1^{m}	$= 0^{\text{s}}{\cdot}178$
☉'s Dec.	$= \delta = 21^\circ\ 27'\ 41''{\cdot}9.$	,, ,,	$= 0''{\cdot}405$
Hour Angle	$= t = 3^{\text{h}}\ 30^{\text{m}}\ 26^{\text{s}}{\cdot}45$ E.		
Altitude of ☉	$= 41^\circ\ 49'{\cdot}5$		
☽'s R.A.	$= A = 4^{\text{h}}\ 22^{\text{m}}\ 28^{\text{s}}{\cdot}76.$	Change in 1^{m}	$= 2^{\text{s}}{\cdot}484$
☽'s Dec.	$= D = 21^\circ\ 53'\ 6''{\cdot}36.$	,, ,,	$= 2''{\cdot}529$
☽'s Hor. Par.	$= P = 58'\ 25''{\cdot}79$	$P - p = 58'\ 17''{\cdot}06$	
☉'s Hor. Par.	$= p = 8''{\cdot}73$		
☽'s Semi-diam.	$= S = 15'\ 55''{\cdot}30$	$S - s = 8''{\cdot}71$	
☉'s Semi-diam.	$= s = 15'\ 46''{\cdot}49$		